IPRO308: The Artificial Pancreas

IPRO Day Progress Update
November 30th, 2007
Diabetes

- **Diabetes:**
  - Type 1: Deficient Insulin Production
  - Type 2: Insulin Resistance
  - Manifestations: Poor Circulation, Weight Gain

- **Complications**

- **Insulin:**
  - Regulates glucose absorption into tissues for metabolic needs
  - Improper balances may be fatal
Glucose Pumps and Sensors

- Current Glucose Pumps and Sensors
  - Invasive and uncomfortable
  - Non-Invasive sensor research
IPRO 308: Unique Approach

- Sonophoresis
- Reverse Iontophoresis
- Vacuum
- Spectroscopy
- Iontophoresis
Administrative Structure

- **Team Leader:** Michael Morley
- **Secretary:** Linda Goldstein
- **Webmaster:** Rohan Mathews
- **Subcommittee Leaders:**
  - Bhavin Patel (Extraction)
  - Kirthi Reddy (Measurement)
  - Margaret Kochanek (Research)
Research Subcommittee

- Patent Search
- Research for various committees
- Grant Applications
  - National Collegiate Inventors & Innovators Alliance (NCIIA)
  - Ford Foundation
- Deliverables
  - Project Plan
  - Mid-Term Report
  - Code of Ethics
Ethical Levels of IPRO 308

1. Moral Values
2. Personal Relations
3. Community
4. Industrial Standards
5. Professional Codes
6. Contracts
7. Law
Extraction Subcommittee

EXPERIMENTATION

- Pig Skin - Closest available substitute for Human skin
- Difficulty obtaining fresh skin for every experiment
- Thickness and age of the skin vital to success of experiment
THE PROTOTYPE

The Basics

- Tweeter speaker
- Hole through magnet for vacuum
- Conductive epoxy for iontophoresis
THE PROTOTYPE

Initial Design

- Speaker without hole
- Vacuum pulled through gasket
- Base-plate for iontophoresis
- RTV to seal the vacuum and prevent air gaps
THE PROTOTYPE

A new approach to Iontophoresis

• Epoxy unlevel and inadequate
  • Aluminum base-plate
• Conductive and adhesive foil on speaker coil
THE PROTOTYPE

A new approach to Vacuum suction

- Extraction group worked to maximize vacuum suction
- Modeled with a PVC pipe cover
- Tested grid design
- 13 in Hg
THE PROTOTYPE

The Final Design

- Base-plate
- Gasket with tube for vacuum
- Speaker with wires to leads
- PVC piping
Extraction: Results

Normal pig skin before experiments.

After iontophoresis, sonophoresis, and vacuum

20X Magnification with a compound microscope
15 Min
Measurement: Results

- Past: Spect. methods
  - Beer Lamberts Law

- Problems:
  - Glucose absorbance at 3000 nm, while spectrophotometers only measure accurately to 1500 nm. Non-linear relationship produced

- Solution:
  - Use of Glucose Benedicts Solution. Absorbance at 730 nm

\[
y = 0.0908x + 0.26
\]
\[
R^2 = 0.9994
\]
Looking to the future

- Attain rat skin for better results
- Miniaturize technologies to fit prototype
- Identify methods for:
  - Preparing Benedict’s Sol.
  - Cleaning chamber
  - Interstitial glucose-insulin algorithm
  - Administering Insulin
Special Thanks..

- Dr. Emmanuel Opara
- Mr. Ray Deboth
- Dr. Stark
- Dr. Bishnoi
- Dr. Williams
- Dr. Myron Gottlieb
- Dr. Jennifer Derwent
- Dr. Promilia Dhar
- Dr. Khaleil
Questions?